DOCUMENT RESUME

ED 232 130 CS 007 178

AUTHOR Mason, George E.
TITLE Advantages and Disadvantages of the Computer as a Teacher of Reading.
PUB DATE Dec 82
NOTE 20p.; Paper presented at the Annual Meeting of the National Reading Conference (32nd, Clearwater Beach, FL, December 1-4, 1982).
PUB TYPE Speeches/Conference Papers (150) -- Viewpoints (120) -- Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Computer Assisted Instruction; Computer Programs; *Computers; Elementary Secondary Education; Input Output Devices; *Reading Instruction; *Reading Teachers; Teaching Methods

ABSTRACT

The computer has at least eight features that can be advantageous to the reading teacher and the learner: the computer (1) is interactive--the print can change sizes and colors, blink on and off, and roll up or down the screen; (2) is immediate--it can respond or interact far faster than can either the teacher or learner; (3) is impassive--it is a nonthreatening, nonjudging machine; (4) focuses attention--the changing light patterns on the surface of the cathode ray tube (CRT) are a constant reminder to the viewer that the display can and does change; (5) is absolutely dependent upon its programs (or programer); (6) can vary parameters; (7) permits skills to be embedded in games; and (8) can keep records. Unfortunately, not all of the computer's characteristics are advantageous. For example, the low cost of electronically stored and displayed text is low cost only after relatively expensive computing equipment has been purchased. A second problem is quality. However, the computer's major disadvantages are inherent in the characteristics of its displays: it is dependent upon electricity, and its printouts are often difficult to read. Furthermore, the CRT is a limited display device. Finally, the CRT can cause vision problems. (HOD)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED232130

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
X This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

Advantages and Disadvantages of the Computer as a Teacher of Reading

by

George E. Mason
University of Georgia

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
George E. Mason
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Introduction

Both the education press and popular press have been filled with news of the entry of computers into homes and classrooms. A recent AEDS Newsletter describes an impending contract which will enable Florida's public educational entities to buy computers without going through the bid process (FLA micro contract, 1982). On the very same page the reader finds that Stevens Institute has joined the group of colleges and universities* requiring freshmen to own personal microcomputers (Freshmen must own micros, 1982). Education Week, of October 27, 1982, describes a joint project in which the Educational Products Information Exchange (E.P.I.E.) has joined Consumer's Union to evaluate computer systems and equipment for the education market. In that same issue, it is reported that Pennsylvania is planning to require computer courses for eighth-graders by 1984 and that its state education department has developed its own computer literacy course for teachers.

And in France, the French phone company has offered a terminal to every one of its customers in the city of Rennes (Faflick, 1982). The

*Carnegie-Mellon University, Clarkson College, and Drexel University either provide students with computers or require them to buy (Williams, 1982).

CS 007 178

terminal will replace the telephone book and information operators. It should save the company thousands of dollars in personnel, printing, and mailing costs over the next few years. It appears likely that American telephone companies will soon follow suit. In the near future part of the daily lives of most Americans will probably include typing on the keyboard of a computer or computer terminal and reading text printed out by a computer's printer or displayed on its cathode ray tube (CRT) screen.

The increasing presence of the computer in homes and schools has led reading teachers to react in differing ways. Some have examined a few of the available computerized reading programs and rejected them as simply electronic workbook pages. Others, marvelling at the computer's ability to repeat pupils' names and offer reinforcing statements when correct answers are entered, have embraced computer-assisted instruction (CAI) as the methodology of the future.

Fortunately, relatively few reading specialists have taken either of these two extreme positions. Most are trying to learn more about computers and CAI before crystallizing an opinion. The purpose of this presentation is to provide some of the information these reading specialists seek.

Advantages of the computer

The computer has at least eight features which can be advantageous to the teacher and/or the learner. These are as follows:

1. The computer is interactive. It can provide instructions at a level and of a type varying with the initial responses (and subsequent responses) of the learner.
2. The computer is immediate. The provision of new material immediately follows the response input by the learner. There is no waiting for the teacher to score the learner's work.

3. The computer is impassive. It presents materials to learners without emotion (even though it may be presenting the same information for the forty-seventh time!).
4. The computer focuses attention. The patterns of light rays and the graphics on the screen seem to hold attention better than books.
5. The computer is absolutely dependent upon its programs (or programmer). Since it must receive instructions correctly spelled and punctuated, and in proper sequence, it is an appropriate tutee for poor readers to tutor.
6. The computer can vary parameters. Levels of difficulty, amount of branching, degree of graphics support, and frequency of testing can be determined by the programmer or (with some programs) can be set by the teacher.
7. The computer permits skills to be imbedded in games. Other highly motivating activities such as simulations can also be used for developing reading skills.
8. The computer can keep records. Intricate and extensive records of learner responses can be easily saved by the computer for later examination by the teacher.

Each of these advantages will be discussed under a separate heading.

The computer is interactive

Unlike the print in textbooks, the print on the computer screen can change sizes and/or colors, blink on and off, and/or roll up or down the screen. These various options (as well as the option of showing of moving or still graphics) are often determined by the responses of learners to the instructions given by the computer. Moore, Nawrocki, and Simutis (1979) have provided guidelines for the use of graphics in support of CAI programs. While it is true that some CAI-reading programs reinforce a correct response only by showing the word "correct" on the screen, others show explosions and/or rockets firing and some even allow the learner to type in the response he/she would like the computer to make when a correct answer has been entered (Dworkin, 1982).

The computer is immediate

The electronic circuitry of the computer allows it to check single answers or groups of answers and to respond or interact far faster than

either the learner or the teacher can. In fact, performing simple scoring, counting and immediate reinforcement tasks for the teacher may be the computer's greatest contribution to the improvement of instruction. It can save teachers hours of time while providing students with immediate knowledge about the success of their efforts. The computer also can produce encyclopedia references faster than a librarian can get out the right volume and it can reprint an experience story which, if recorded in traditional fashion, a teacher might have buried in a stack of similar stories (Way, 1969).

The computer is impassive

The computer's circuitry consists of thousands of switches which are either "off" or "on" at high or low voltage levels. These switches have no personality and no emotions. Learners whose experience with books has taught them to fear the laughter of their friends and/or the disapproval of their teachers can relax as they interact with the non-threatening, non-judging machine.

While most of the CAI-reading programs which can be presented to children do offer reinforcing statements or graphics, relatively few display any sort of commentary after an incorrect response has been made. "TRY AGAIN" is one common indicator that an incorrect response has been made. Often the computer simply repeats the display of the frame or item. Sometimes this repetition is available indefinitely (or as long as incorrect responses continue), whereas in some programs the correct answer is displayed after a set number (usually less than 4) of incorrect responses have been entered.

In some programs, such as Scott, Foresman Electronics Early Reading module (Hausen, 1980), all answers are correct and reinforcing. The child's

responses determine how the plot of the story proceeds. Children soon learn to choose the plot sequence they like best. (As yet we do not know the effect of this type of program on comprehension or sequence.)

The computer focuses attention

The changing light patterns on the surface of the CRT are a constant reminder to the viewer that the display can and does change. Unlike the book page, a constant unchanging display, the CRT can flash its print, reverse-screen (so that black print appears on a white background), expand the size and move it around. O'Bryan (1975), studying children's visual attention to The Electronic Company (not computer-controlled, but nevertheless a CRT-displayed set of programs), has stated a number of conclusions about children's attention to print displayed on the TV (or CRT) screen.

1. Good readers direct their eyes to printed material as soon as it appears on the television screen. They rarely look back to the words left on the screen. Instead they direct their visual attention (or at least their gaze) to changes in words displayed and to additions, deletions or expansions of the printed message.
2. To the good reader, the positioning of the print and the accompanying display appears to make no difference in his visual responsiveness. However, there are notable differences between the response of good readers and of poor readers. Poor readers often are distracted from the print by televised action. The direction of their eye movements to the print frequently ends after they observe the first two or three letters of the words displayed. Poor readers tend to take longer to fixate on printed material and consequently they often stop looking before a whole word is observed. When their gaze returns to the print, it usually returns again to the first few letters.
3. Poor readers did observe words adequately when the words were formed (typed out) by the computer and when they were animated. More fixations and longer fixations on words resulted from such presentations on the screen.
4. Non-readers looked at printed material on the television screen with random eye-movement patterns. Some attention to print was associated with animation of print, but single words or sentences were likely to be examined with a pattern that started in the middle of the printed display. Any action was likely to draw the visual attention of the non-reader away from the print.

5. When flashing letters are shown, non-readers fixate longer on these letters than do good or poor readers, but they then ignore (not fixate on) the rest of the word.
6. For placing printed messages, the best position on the screen is central.
7. Balloons draw more attention from viewers than other presentations of printed messages.
8. Zoom boxes are very effective. As the print expands, viewers watch intently.
9. Static print is least effective. Some sort of motion is helpful to poor readers.
10. When televised action is followed by printed messages, poor readers observe the printed stimuli in much the same fashion as good readers.

By generalizing O'Bryan's findings to computer-CRT displays, it seems rational to believe that the attention-getting and attention-holding capabilities of the computer-controlled CRT are vastly superior to those of the printed page. Confirmation of that belief comes from classroom teachers who find the computer to be appropriate reading practice for groups as large as five (Joyce, 1981).

The computer is absolutely dependent upon its programs

The cluster of switches which we call computers execute pre-set series of instructions called programs. The programs are ordered sets of commands which must be precisely worded, spelled, and punctuated. Leaving out a comma, changing a colon to a semi-colon, or misspelling the command "GOTO" as two words can cause a program to hang up or fail to execute properly.

Remedial reading teachers find that teaching their pupils to program is an effective method of teaching visual discrimination. Even having pupils copy programs listed in manuals or computer journals seems to help (Mason and Blanchard, 1982). And the uncomplaining, totally-dependent machine must be "taught" to execute its programs by the child, its programmer. (When my own students start complaining about the "dumb" machine, I make a mental note that they have reached a new plateau in cybernetics.)

A few programs that I like

Programs which can be executed by computers are available for mainframe computers, minicomputers, and microcomputers. Among the mainframe programs of most interest are those commercially available from the Computer Curriculum Corporation, Control Data Corporation, and from the Timshare Corporation (Houghton-Mifflin). However, investigators and developers in private industry are presently completing several very promising programs which may one day be available to schools. Nix (1982) has described a discourse analysis-based computer system which enables readers to find the "links" between feelings, reasons, and words expressed in written text. This is being developed at IBM Laboratories. Frase (1982) has described "Writer's Workbench," another program which may eventually find its way into school applications. It's being developed at Bell Laboratories.

But of much more interest are programs which have been developed during the past fifteen or twenty years and which are therefore available now. These can be divided into several categories.

Skills instruction

In drill and practice programs, a few formats predominate. In one format, an incomplete sentence appears on the screen with three or four words or phrases to choose from. The student chooses a word to fill the blank and then is reinforced (if the answer is correct) or told to try again. A second format often used is the tachistoscopic presentation of a word followed by a request to spell it. A third format involves a graphic (often cartoon-like) display and a choice among words or phrases, one of which describes or in some way fits the picture. The child responds by reading or inspecting the screen and then by typing a number, letter,

or word on the screen. Almost never is the response more than a word and seldom is reading fluency or comprehension of long complex passages one of the goals. However, some of the most recent programs involve combining the testing and reinforcing capabilities of the computer with books displaying long printed passages. These have great promise. Computers can (1) pronounce words as soon as the student types them, (2) show pictures and graphs which change with student input and increase understanding, and (3) assess student progress in reading book-length passages.

Conversations

A small number of programs carry on a conversation with students. The best known of these, ELIZA (available from Radio Shack), starts by displaying "WHAT IS YOUR PROBLEM?" If the student types, "I hate you!", the computer may respond, "We're talking about you, not me," or "How long have you felt this way?" Middle school children may enjoy hours of conversation with ELIZA (which will respond to any typed statement). Since the student must type, he gets both reading and writing practice.

Story creators

Programs which help students create stories or poems make use of the computer's ability to draw a random selection from a group of words, phrases, or sentences. One program, STORY BUILDER (available from Scholastic), will create zany sentences to illustrate the roles played by parts of speech in sentences.

Another program named STORY BUILDER (from Random House) is designed to teach syntax and story components by providing a "mix and match" format. Students experiment with sentence structure and create new stories.

STORY STARTER (also from Random House) provides elementary level students with practice in constructing cause-effect and time sequence stories. There are three difficulty levels with ten opening lines per level. The student types after reading the first line.

Games

Nearly all computer games require some reading. However, many games are designed to teach reading skills. ALPINE SKIER (available from Data-Command) shows a human skiing and meeting a gate. In order to clear the gate the student must decide whether a passage is a cause or an effect, or whether it is a fact or an opinion. Right choices keep the skier moving. Wrong choices bring on a spill for the skier.

Other games for which there are a great many programs include the spelling-guessing game that once was called hangman, tic-tac-toe, concentration, cryptograms, scrabble, and target shooting. In these, screen graphics are used for motivation, context, and/or reinforcement.

Prereading activities

Educational software companies distribute simple programs for young children. ALPHABET KEYBOARD, by Bertamax (from Random House) teaches kindergarten and first grade children to find letters and type them in alphabetical order. LANGUAGE ARTS SEQUENCES (from Milliken Publishing) also provide practice in letter recognition.

This list is by no means exhaustive. There are many good software programs for teaching reading and managing reading programs. Unfortunately, there are many more which are not well designed for teaching reading. As always, the buyer should examine before purchasing.

The computer can vary parameters

Computer programmers can create programs at low levels of readability, with frequent branching, and with a high degree of graphics support, but so can textbook and workbook authors. However, computer programs can cause the variations to be contingent upon the patterns and/or rates of pupil response. Textbooks can be selected to match pupil needs, but textbooks cannot change their pages as pupil responses change. In flexibility to meet student achievement needs, the computer has a decided advantage.

The computer permits skills to be imbedded in games

Electronic arcade games have taken the Western world by storm. In playing arcade games, the player must carefully watch the screen and react rapidly to the displays presented there. By pressing buttons and manipulating levels, the player "wins" at the first difficulty level and sees a score reflecting his accuracy and skill. Winning cause the game to progress to a more difficult version with which the player again attempts to earn a winning score. If the player continues to win, the game continues to add to his score and to increase until the maximum difficulty level is reached. The player who wins at this level continues to score points until exhaustion ends his play.

The gradually increasing levels of difficulty and the intriguing visual displays maintain a constantly high level of motivation in the players. Differences in talent affect the length of time the player plays, but all players win to some extent. And they play again and again.

For reading skills which need to be practiced repeatedly in order for automaticity to be developed, the arcade game formula offers great promise. Matching words, filling blanks, and deleting extraneous statements can be embedded in exciting games which bring about the practice

necessary for automaticity. Some research and development projects are now creating just such games (Beck, 1982) and two such games (from Children's Television Workshop) have just been announced by Apple (n.d.).

The computer can keep records

Many of the better programs cause the computer to save the responses of the pupils who interact with them. What can be saved includes: 1) the number or percent of correct or incorrect responses, 2) the exact responses made, 3) the time per response or per lesson, and/or 4) the last lesson (and its difficulty level) completed at the criterion performance level. Programs which provide the teacher with records not only enhance the teacher's options for individualizing instruction during class hours, but also save after-class scoring and recording time. With the best CAI-reading programs, the effort required for good teaching can actually be reduced somewhat.

Disadvantages of the Computer

Unfortunately, not all of the computer's characteristics are advantageous. Some of its advantages may be disadvantages when viewed from a different perspective. For example, the low cost of electronically stored and displayed text is low cost only after relatively expensive computing equipment has been purchased. Some schools have decided that they must purchase or build lockable carrels. Their computers are a security problem.

A second problem is one of quality. All of the sketchy, poorly prepared "reading workbooks" which once were available through dime stores and supermarket checkout counters seem to have been recreated for

marketing as computer disk (or tape) programs. Just as many basal reader workbooks are too difficult for the reading skill of the pupils for which they are intended (Fitzgerald, 1979), so are many CAI-reading drill-and-practice programs too difficult for their intended students.

Another common quality problem is that the instructions, directions, and reinforcing statements for some programs are more difficult to read than the text which the program is designed to teach the reading of.

However, the computer's major disadvantages are not those which it shares with books. It's major disadvantages (other than initial cost outlay) are inherent in the characteristics of its displays. These are as follows:

1. The computer is dependent upon electricity.
2. Computer printouts are often difficult to read.
3. The cathode ray tube (CRT) is a limited display device.
4. The cathode ray tube (CRT) can cause vision problems.

The computer is dependent upon electricity

For computers to load and unload their programs, and for them to execute those programs without any "glitches," their electric supply must not vary significantly. Variations in power can cause the CRT screen image to shrink, or can send wavy lines moving up or down the screen. And, since electric machinery does generate heat, some computers break down in warm rooms unless a fan is installed to blow through their interiors or unless their covers are removed. Needless to say, removing the cover from a computer and thus exposing its circuitry is not advisable in an elementary school.

Many schools were built before the age of school television receivers, tape recorders, electric typing, duplicating, and copying. The wiring in such schools is often already overloaded. The single electric outlet in

the front of the room is used for the big clock and the TV set. Not only is the supply of electricity in the school inadequate for the computer (even though it uses comparatively little), there may be no place to plug it in.

Computer printouts are often difficult to read

When a computer is used in the creation of messages or stories to be printed-out with a printer, it is called a word processor. Many experts (Henning, 1981; Marcus, 1982) are now claiming that reading and writing skills can be enhanced by using word processors in the classroom.

The computer can control a variety of printers. The cheaper ones are dot matrix printers. Their letters are a matrix of dots — the more dots employed, the better the shape of the letter produced. Many of the inexpensive dot matrix printers approximate letter shapes rather poorly. This limits their utility for beginners and poor readers. Yet they are quiet enough for many classrooms.

The more expensive devices are daisy wheel printers. They are too noisy to use in the typical classroom, but the quality of their print is higher than that of the dot matrix printers. However, even the daisy wheel printer may not offer true descenders — the g, j, p, q, and y may be compressed so that the tail is "on the line." This, of course, changes the configuration of many words and may decrease the reading efficiency of the better readers.

Many printers can justify their lines of print so that the margins on both sides are perfectly straight. The resulting messages, while pleasing to the eye, are nevertheless more difficult to read than those not justified on the right side. In this case we find that the computer's potential is not necessarily advantageous to the reader.

The cathode ray tube (CRT) is a limited display device

Most CAI reading programs are presented to students on a CRT, which is the same tube as that we call the "picture tube" on our TV sets. The cathode ray tube can present pictures and print, just as a page in a book can. However, the amount of print which can be presented on one screen is much less than what can be presented on one page. While a typical book page may display 250 to 500 words, a typical CRT should include less than 100, because legibility requires double-spacing of lines. Although Hoover (1977) found single-spacing to be adequate for college students, his finding is in conflict with the opinions of most specialists in computer-assisted instruction. Furthermore, since some CRTs tend to blur the edges of their screen images, programmers often leave wide margins in order to ensure clear text on the screen. Since so few words can be presented on the screen at one time, the reader must "turn more pages" with the computer than he would turn in a book. This inefficiency is leading some publishers to create programs in which books and computers are paired in order to use both advantageously.

Most of the inexpensive microcomputers can display only capital letters on their CRTs. While this seems to present no problems to intermediate grade pupils of average ability (Gerrell and Mason, in press), the use of entirely upper case letters has been shown to reduce the efficiency of adult reading of book print (Tinker, 1928) and it seems probable that the use of upper case letters also reduces adult reading efficiency when the text appears on the CRT. It may also be more difficult for beginners and poor readers, but research has not yet determined whether such is, in fact, the case.

Still another problem becomes apparent when color computers are used. With some of these, whenever colored pictures are presented on the screen, multiple colors appear in the letters displayed. The colors appearing in various parts of the letters often makes the print nearly illegible.

Some of the very inexpensive computer chip devices, such as the Speak-and-Spell, use L-E-D displays which show block letters made of various arrangements of straight lines. While use of these devices has been demonstrated to be helpful to poor readers (Abey, 1982), the implications of their text display formats are unknown. (Of course, the producers are already pairing their programs with texts and workbooks, and consequently an evaluation of their impact may forever be impossible.)

The cathode ray tube can cause vision problems

Nearly everyone who has spent much time sitting in front of a computer CRT is aware of the glare problem. Screen glare is a constant.

One kind of glare can be modified or even eliminated. This is glare relected off the CRT's glass screen. Light bulbs, sunlight coming through windows, and even light-colored objects reflect into the eye of the viewer. To reduce this glare, computer owners drape their windows, fix visors over their screens, and hang egg-crate shielding under their overhead flourescent bulbs. Some are buying tilt turntables so that screens can be tilted down to reflect light below the viewer's line of sight. Others place their faith in elevator stands which enable CRT viewers to raise or lower the CRT to maximize the viewer's eye and body comfort. Fortunately, some computer CRT manufacturers have begun building tilt and elevation controls into their viewing screens.

The second kind of glare can be reduced, but as yet no method for eliminating it has been developed. When excited by the electrons flowing

from the cathode-ray "gun" at the back of the tube, the flourescent front surface of the tube glows, sending light rays directly toward the eyes of the viewers. In recent years the Newspaper Editors' Guild has several times asked the National Institute of Occupational Safety and Health (NIOSH) to investigate the effect of CRT-viewing on the human body, especially the eyes.

In May of 1981, the NIOSH team reported that they found no radiation hazard, but that the eyestrain problem was severe. Nearly three quarters of all the regular CRT-users had vision-related complaints, whereas only 27.4% of the non-CRT-users had them. The CRT-users also had nearly twice as many other physical complaints (Video display terminals blamed for aches, pains, 1982). NIOSH recommended that employees who spend most of their time watching CRT screens be given fifteen minute breaks every hour. Such a recommendation must be considered by administrators of schools planning extensive use of CAI-reading programs. The scheduling of children's viewing time should be a topic for great concern.

Summary

Although the advantages of the computer are numerous, most of those stated should be thought of as potential advantages because not all programs capitalize on the computer's potential. For example, although all computer CAI-reading programs could be interactive, not all are. Some provide no more interaction than a workbook. Furthermore, the computer's impassivity can be disadvantageous, since the computer cannot share one's excitement over the successful completion of a task nor provide comfort when mistakes lower one's self-esteem. As was stated earlier, the computer is absolutely dependent on its programs.

The concerns of the reading educator, then, should be largely devoted to the quality of the programs available for teaching reading. However, reading educators must also be concerned about the display vehicles, printouts, and CRT screens. Differences in print style, case, letter quality, and line format may well be disadvantageous to some readers. And, finally, visual fatigue problems should be of great concern to educators. The fact that industry is making greater use of electronically stored and transmitted text than education provides education with some lead time in which to study computer-generated CRT-screen displays of text before its wholesale adaption by schools and colleges.

References

Abey, C. Teaching basic skills — an electronic alternative for remedial students. Paper presented at the annual conference of the Georgia Council of the International Reading Association. Atlanta, March 1982.

Beck, I. A. Personal communication. July 1, 1982.

Children's Television Workshop. Quick Match and Scramble, on INSTANT ZOO (diskette). Cupertino, California: Apple Computer, n.d.

CRT operator guidelines devised. AEDS Bulletin, August 1981, 1.

Consumers Union joins with EPIE in computer project. Education Week, October 27, 1982. 2.

Dworkin, N. Ten characteristics of computers for use in instruction. Paper presented at the Eighth Southeastern Regional Conference of the International Reading Association. Biloxi, Mississippi, November 1982.

Faflick, P. A terminal in every home: the bold French plan for giving away electronic phone books. Time, September 13, 1982, 65.

Fitzgerald, G. G. Why kids can read the book but not the workbook. The Reading Teacher, 1979, 32(8), 930-932.

FLA micro contract. AEDS Newsletter, 1982, 1(3), 2.

Frase, L. Using the computer in analyzing texts. Paper read at the annual conference of the American Educational Research Association. New York, March 1982.

Freshmen must own micros. AEDS Newsletter, 1982, 1(3), 2.

Gerrell, H. R., & Mason, G. E. Computer-chunked and traditional text. Reading World (in press).

Hausen, J. (Reader-consultant), Early Reading. Glenview, Illinois: Scott, Foresman Electronic Publishing, 1980.

Henning, D. G. Input: Enter the word processor. Language Arts, 1981, 58(1), 18-22.

Hoover, T. Empirical study of reading and comprehension as a function of CRT display. ERIC Document Reproduction Service (ED 161 002), 1977.

Joyce, P. Personal communication.

Marcus, S. The muse and the machine: A computers and poetry project. Classroom Computer News, 1982, 3(2), 28-31, 82.

Mason, G. E., & Blanchard, J. S. Reading teachers put the computer to work. Classroom Computer News, 1982, 2(5), 44-45.

Merrill, P. F., & Bunderson, C. V. Guidelines for employing graphics in a videodisc training delivery system. ISD for Videodisc training systems. First annual report, Volume III. Orem, Utah: Wicat, 1979. ERIC Document Reproduction Service (ED 178 057).

Moore, M. V., Nawrocki, L. H., & Simutis, Z. M. The instructional effectiveness of three levels of graphics displays for computer-assisted instruction. ERIC Document Reproduction Service (ED 178 057), 1979.

Nix, D. H. Using artificial intelligence to begin teaching reading comprehension. Paper presented at the Third annual conference of the American Reading Forum. Sarasota, Florida, December 1982.

Siegel, M. A., & Simutis, Z. M. CAI for adult basic skills training: Two applications. Paper presented at the 24th annual convention of the International Reading Association. Atlanta, Georgia, May 1979.

Tinker, M. A., & Paterson, D. G. Influence of type form on speed of reading. Journal of Applied Psychology, 1928, 12, 359-368.

Video-display terminals blamed for aches, pains. The Arizona Republic, June 27, 1982, c3.

Way, F. L. The language-experience approach in teaching reading — computerized. Computer Automation, 1969, 19(9), 28-30.

Williams, D. A. The computerization of CMU. Newsweek, November 1, 1982, 91.